IMPLEMENTATION OF LABORATORY SAFETY PRACTICES AMONG SENIOR SECONDARY BIOLOGY STUDENTS IN AWGU EDUCATION ZONE

Prof. Olive I. Neboh & Obi Eunice Azuka
Department of Science Education
Enugu State University Of
Science and Technology, Enugu

ABSTRACT
In recent times, there have increase in laboratory accident such as fire outbreak, heat burns, cuts and scrapes, spill of chemical and the likes, in biology laboratory. It becomes expedient that in general design of biology laboratory, lighting, ventilation, spacing of tables and stools, wider walkways to avoid congestion during emergency and proper supervision during biology laboratory work are not put into consideration. Entrance and exit doors are not properly fixed for easy movement. The fact that some Biology Laboratory assistants are well trained to do the job bring about their inability to arrange and label chemical and reagent bottles properly has contributed greatly in biology laboratory accident. The purpose of the study is to ascertain the implementation of laboratory safety practices among senior secondary biology students in Awgu Education zone. Specifically, the study sought to find out extent to which general design of Biology Laboratory is relevant to implementation of safety practices and also the laboratory assistant's ability to arrange and label chemical and reagent bottles ensure implementation of safety practices in biology laboratory. Two research questions and two research hypotheses guided the study. The presentation and analysis of the result was done according to the research questions and research hypotheses. The recommendations are that in general design of the Biology Laboratory, safety of the students and all laboratory users should be the priority, among others.

Keywords: Laboratory, safety, practices and students

INTRODUCTION
Biology is one of the major science subjects concerned with composition, structure and properties of matter, as well as changes it undergoes during chemical reaction in the body of or organisms. Biology can also be referred to as the study of living things (plants and animals) (Idodo Umeh, 2015). In recent times, there have been increase in laboratory accident such as heat burns, chemical burns, cuts and scrapes, inhalation of poisonous gases, spill of chemicals, among others.

It becomes expedient to question about the general design of the Biology Laboratory, such lighting, ventilation, spacing of tables and stools, walkways for proper supervision during laboratory work.

Another inquiry is to be made about the Laboratory assistants employed in Biology laboratory, to find out whether they are able to arrange and label chemical and reagent bottles properly to ensure the implementation of safety practices in Biology laboratory. Bell, (2014)

There are few theories of laboratory safety in the literature, Two theories are used to anchor the study. There are:

Theory of Industrial Safety by Mark Karty (2001) and Theory of Environmental safety by James Yeong (2003).

Theory of Industrial safety by Mark Karty. Mark-Karty (2001) theory of industrial safety, state that safety hold the success of every industrial undertaking and if safety practices is not carried out to that point where safety of life and equipment are guaranteed then such industrial undertaken should be abandoned or re-designed. The theory emphasizes that life is supreme in anything one is doing in terms of work and work related activities. This implies that workers should be giving adequate training in industrial safety. The need for industrial safety training programme provides workers with specific procedures for handling various materials operating different kind of mechanical and performing various tasks safely while at the same time ensuring maximum organizational productivity. It is in the contexts of these, that Peskin (2002)) noted that the totality of man's activities on earth is to ensure safety and the quest for happiness and that in pursuing these goals man has devised a lot of activities and measures to protect himself from danger which ensure continuity of life free from pains and hence ensure happiness. Peskin further emphasized that in every industrial endeavors, there is always the observance of some precautions aimed at freeing man from danger or accident in the industry, in biology laboratory, workshop and other industrial related workplaces. Safety is the most important aspect for training in every occupation because people work safely to live and live by working safely, noted Umoru (1999). A safe worker is one who works today and is able to work tomorrow while an unsafe worker today and unable to work tomorrow due to injuries sustained yesterday. Every occupation has its own hazards and it is this hazard that is being protected against that is termed safety. Hazard assessment is therefore, very important for every job in order to extract safety elements of guides for every task. According to Hopper (2003) hazard assessment is a process that reviews jobs and tasks to identify potential hazards and find ways to perform the jobs without risking the health and safety of the worker and the environment, if safety training is not giving enough prominence in an occupational training, then such training is dangerous and neither beneficial to the individual nor to the society and therefore should be discarded (Kasin 2000). This theory is talking about people being trained on safety practices before embarking on laboratory activities for maximum implementation of safety practices in biology laboratory. The theory has implication for the study, which is set to find out the extent these safety practices are being implemented by the senior secondary school students in Awgu education zone.

Theory of environmental safety by James Yeong. James Yeong (2003) propounds that biology laboratory practical's should include information and activities designed to

protect and conserve human life. This implies that training of laboratory workers should emphasize safety information and programmes as sine-quanon effective training that ensures conservation of life. Procers and Guily's (1980) principle of technical education management, though was developed in the eighties, it is still very relevant to date. It states that laboratory activities will be efficient in proportion as environment in which the workers and students are trained, is a replica of the environment in which he must subsequently work. This principle has safety implication because when one is trained in the same environment in which he must subsequently work, it will sharpen the trainee's awareness and experience of safety consciousness in such environment since the environment is not new to him. According to Udoma (2001) students who were trained by this concept show better performance in both safety practices and production procedure. In conclusion therefore, much of what may be said about industrial and laboratory safety revolves around these theories. This theory emphasizes that training the laboratory users on the use of equipment will help sharpen their awareness and experience on the implementation of safety practices in biology laboratory.

The study of biology should be accomplished with practical learning as it forms the basis to the study of applied sciences such as medicine, agriculture, pharmacy, nursing, among others. Teaching and learning of biology is more successful and fruitful when scientific process skills of observing, classifying, comparing, inferring , measuring, predicting, manipulating, hypothesizing, experimenting, identifying, controlling and concluding are acquired and utilized by biology students. Almost all the scientific process skills listed above are carried out in the biology laboratory, Sirum and Humburg (2016).

In recent times, there have been an increase in laboratory accident such as fire outbreak, heat burns, chemical burns, cut and scrapes, contamination, inhalation, spill of chemicals and the likes in the biology laboratory. It becomes expedient that in general design of Biology Laboratory, lighting, ventilation, spacing of tables and stools, walkways to avoid congestion and proper supervision during Biology Laboratory work are not put into consideration. Entrance and exit doors are not properly fixed to avoid congestion during emergency.

Some Biology laboratory assistant fail in their duties which include arranging and labeling chemical and reagent bottles properly and this has contributed greatly in laboratory accident. The laboratory assistant work in biology laboratory settings, preparing experiments, processing specimens, maintaining laboratory material and equipment and cleaning up after experiments.

The fact that laboratory assistants are not trained to do this job, some are posted in the schools to do the job of clerical officers. For shortage of laboratory assistants, the school will convert them to laboratory assistants which has done more harm than good to the extent of implementation of safety practices in Biology laboratory.

PURPOSE OF THE STUDY

The purpose of the study is to ascertain the extent of implementation of safety practices in secondary school biology laboratories in Awgu Education Zone. Specifically, the study sought to find out the extent to which:

1. General design of Biology laboratories are relevant for implementation of safety practices.
2. The laboratory assistant's ability to arrange and label chemicals and reagent bottles ensure implementation of safety practices in Biology laboratory.

RESEARCH QUESTIONS

The following research questions guided the study:

1. To what extent are general designs and fittings of biology laboratories relevant for implementation of safety practices in the Biology laboratories?
2. To what extent do the laboratory assistant's ability to arrange and label chemicals and reagent bottles ensure implementation of safety practices in the Biology laboratories?

HYPOTHESES

The following null Hypotheses tested with t-test statistics at .05 level of significance guided the study.

Ho_1: There is no significant difference between the response of male and female teachers on the general design and fittings in biology laboratory and extent implementation of safety practices in biology laboratory.

Ho_2: There is no significant difference between the responses of male and female teachers on the laboratory assistant's ability to arrange and label chemicals and reagent bottles and the extent of implementation of safety practices in biology laboratory

METHOD

The study adopted descriptive survey research design. Descriptive survey research design according to Idoko (2011) is concerned with specified population of persons, items or situations in a defined geographical location. It involves the collection of relevant data from or about the population that enables the description of the persons, items or situation the way they are. It does not in any way involve alteration or manipulation of isolated variables associated with the population and or the purpose of the study. This design is considered suitable because it permits the collection of original data from the respondents, describes the present conditions as they exist in their natural settings and only allow a representative of the population to be sampled. The study was conducted in Awgu Education.

The study was conducted in secondary schools in Awgu education zone of Enugu state. The education zone covers three local government areas which include Aninri, Awgu

and Oji-River local government area with 54 public secondary schools located in both rural and urban areas (PPSMB 2016). Aninri local government shares border with Ebonyi and Abia States, Awgu local government shares borders with Nkanu West local Government and Abia State. Oji-River local government Shares border with Amanse in Awka north local government and Aguata local government of Anambra state.

The population for the study comprised all the biology teachers in the secondary schools in Awgu education zone of Enugu state. There are fifty four (54) public secondary schools located in both urban and rural areas (statistics unit, Post Primary School Management Board, Awgu zone (PPSMB 2016). There are one hundred and eighteen (118) biology teachers in all, both rural and urban public secondary schools in Awgu education zone.

The entire population of 118 biology teachers which comprised sixty seven (67) males and fifty one (51) females were used for the study because the population was a finite population. There was no sampling. Therefore, the population size of 118 respondents was used for the study because it is manageable.

A structured questionnaire developed by the researcher consisting of 41 items divided into five sections was used as instrument for data collection. Questionnaire items are arranged in clusters to reflect the specific purposes and research questions. The items were a four point rating scale as shown below: VHE: Very High Extent (4); HE: High Extent (3); LE: Low Extent (2); VLE: Very low Extent (1)

The instrument was subjected to face validation by three experts in the Department of Science and Computer Education, Enugu state University of Science and Technology (ESUT). After validation, the comments, corrections and recommendations of the validations guided the researcher in reconstructing some items.

In order to ascertain the internal consistency of the instrument, the researcher administered 40 copies of the instrument to biology teachers in Agbani education zone. The overall reliability index was 0.82. The instrument was therefore considered suitable for the study.

The copies 118 copies of the questionnaire were administered by the researcher with the help of two research assistants. Out of the 118 copies administered to the teachers, the researcher with her research assistants retrieved 105 copies (58 from male teachers and 47 from female teachers). This resulted to an 88.98 return rate.

The research questions were answered with mean and standard deviation, while the hypotheses were tested with t-test statistic as only two groups of independent variables (male and female) were involved in each of the hypotheses .The decision rule for interpreting the results was based on values of calculated means.

Responses on the research question was considered high (don't reject) when the mean is 2.50 and above, and low (and reject when less than 2.50).The null hypotheses were tested at $P< 0.5$ level of significance. For the hypotheses, the decision rule is that the null hypothesis was not be rejected when the calculated significance value is less than 0.05 and rejected when greater than 0.05.

RESULTS

The presentation and analysis are done according to the research questions and hypotheses.

Research Question 1: To what extent are general designs and fittings of biology laboratories relevant for implementation of safety practices in the biology laboratories?

Table 1: Mean responses of Biology teachers on the extent to which general designs and fittings of Biology laboratories are relevant for implementation of safety practices in the biology laboratories

Biology Teachers = 105

S/N	General designs of biology laboratories are to the following extents: Items	VHE	HE	LE	VLE	$\overline{X}$	SD	Dec
1	Sinks and taps are adequately provided and are functional.	56	29	11	9	3.26	0.96	HE
2	Demonstration table is available and it is well positioned.	44	36	17	8	3.10	.94	HE
3	Windows and doors are provided for free movement and for ventilation.	39	40	14	12	3.02	.97	HE
4	Gas cylinders are fitted outside the laboratory.	55	19	21	10	3.13	1.05	HE
5	Gas taps are functional, closing and opening at will.	44	33	16	12	3.04	1.02	HE
6	Electrical main control switch are situated where the students and teachers can have access to them.	48	36	12	9	3.17	.95	HE
7	Laboratory window can be opened without one having to climb benches.	39	41	14	11	3.01	.99	HE
8	Water always available for cleaning the work place and also spills.	47	36	14	8	3.16	.93	HE
9	Two wide doors are present for easy movement in case of emergency.	21	19	36	29	2.30	1.08	LE
	Grand Mean/SD					**3.02**	**.99**	**HE**

Table 1 shows the analysis of Biology teachers on the extent general designs and fittings of Biology laboratories are relevant for implementation of safety practices in the Biology laboratories. The mean scores of the Biology teachers ranged from 2.30 to 3.26. In

addition, they had grand mean of 3.02which is more than the 2.50 cut off point set for this study. Their standard deviationwas.99. The closeness of the standard deviations indicates that the respondents are homogenous in their responses. Thus, the respondents stated that general designs and fittings of Biology laboratories are relevant for implementation of safety practices in the Biology laboratories in Awgu Education Zone to a high extent.

Research Question 2: To what extent do the laboratory assistant's ability to arrange and label chemicals and reagent bottles ensure implementation of safety practices in the Biology laboratories?

Table 2: Mean responses of Biology teachers on the extent of laboratory assistant's ability to arrange and label chemicals and reagent bottles ensure implementation of safety practices in the Biology laboratories

Biology Teachers = 105

S/N	Laboratory assistants' ability to arrange and label chemicals and reagent bottles are to the following extents: Items	VHE	HE	LE	VLE	$\bar{X}$	SD	Dec
10	Their maintaining an up to date accident inventory.	41	35	18	11	3.01	.94	HE
11	Setting up and dismantling apparatus before and after practical sessions.	35	39	23	8	2.96	.98	HE
12	Proper labelling of specimen, reagents bottles and other laboratory equipment.	37	43	16	9	3.03	1.01	HE
13	Ensuring that damaged and faulty equipment are repaired.	43	38	14	10	3.09	.93	HE
14	Pasting of laboratory safety rules at the entrances of the laboratory at strategic positions.	45	36	17	7	3.13	.96	HE
15	Ensuring proper storage of materials such as chemicals, corrosives, glassware's and so on.	53	31	11	10	3.21	.87	HE
16	Ensuring that animal in the laboratory are properly caged to prevent animal bite.	39	43	15	8	3.08	.95	HE
17	Testing chemical products and monitoring reactions for quality assurance.	46	37	14	8	3.15	.90	HE
	Grand Mean/SD					**3.08**	**.94**	**HE**

Table 2 shows the analysis of Biology teachers on the extent of laboratory assistant's ability to arrange and label chemicals and reagent bottles in ensuring the implementation of safety practices in biology laboratories. The mean scores of the Biology teachers ranged from 2.96 to 3.21 with a grand mean of 3.08 and standard deviation of .94 respectively. The standard deviation shows unanimity in the responses of the respondents. The means of the Biology teachers show that the laboratory assistants have the ability to arrange and label chemicals and reagent bottles in ensuring the implementation of safety practices in Biology laboratories in Awgu Education Zone to a high extent.

Hypotheses

HO_1: There is no significant difference between the responses of male and female teachers on the general design and fittings in Biology laboratory and extent of implementation of safety practices in biology laboratory.

Table 6: summary of t-test analysis on the mean response scores of male and female teachers on the extent of the general design and fittings in Biology laboratory and extent of implementation of safety practices in Biology laboratory

Group	n	$\overline{X}$	SD	Df	t-cal	t-crit	Decision
Male Teachers	58	2.55	0.95	103	0.15	=1.98	Ho_1 not significant
Female Teachers	47	2.52	0.93				

Table 6 shows that the calculated t-value of 0.15 is less than t-crit of ±1.98 at 0.05 level of significance at 103 degree of freedom, therefore, the null hypothesis is not rejected. Thus, there is no significant difference between the mean responses of male and female teachers on the extent of the general design and fittings in Biology laboratory and extent of implementation of safety practices in Biology laboratory in Awgu Education Zone.

HO_2: There is no significant difference between the responses of male and female teachers on the laboratory assistant's ability to arrange and label chemicals and reagent bottles and the implementation of safety practices in biology laboratory.

Table 7: summary of t-test analysis on the mean response scores of male and female teachers on the extent of laboratory assistant's ability to arrange and label chemicals and reagent bottles in the implementation of safety practices in Biology laboratory

Group	n	$\overline{X}$	SD	Df	t-cal	t-crit	Decision
Male Teachers	58	2.54	0.94	103	0.00	=1.98	Ho_2 not significant
Female Teachers	47	2.54	0.90				

Table 7 shows that the calculated t-value of 0.00 is less than t-crit of ±1.98 at 0.05 level of significance at 103 degree of freedom, therefore, the null hypothesis is not rejected. Thus, there is no significant difference between the mean responses of male and female teachers on the extent of laboratory assistant's ability to arrange and label chemicals and reagent bottles in the implementation of safety practices in Biology laboratory in Awgu Education Zone.

SUMMARY OF FINDINGS

The followings are the summary of findings.

1. General designs of Biology laboratories are relevant for implementation of safety practices in the Biology laboratories to a high extent.
2. Laboratory assistants have the ability to arrange and label chemicals and reagent bottles in ensuring the implementation of safety practices in Biology laboratories to a high extent.

CONCLUSION

The general design of the biology laboratory should be geared towards maintaining safety in the laboratories moreover that laboratory assistants should be able to arrange and label chemical and regent bottles properly to ensure implementation of safety practices in Biology laboratory.

DISCUSSION OF THE FINDINGS

The study focused on Implementation of Laboratory safety practices among senior secondary Biology students in Awgu Education zone. The practical activities are fragile. If not properly organized can lead to frustrations, harm, injury and loss of life. That is why it is important that Biology Laboratory designs are done in proper manner and that well trained Biology laboratory assistants are employed for them to be able to arrange and label chemical and reagent bottles properly to ensure safety practices in Biology Laboratory. Mean and standard deviation were used to answer the two research questions. The two research hypotheses were tested with t -test at 0.05 level of significance. The study was

anchored on two theories, The Theory of Industrial safety and the Theory of Environmental safety. The researcher adopted descriptive survey research design. The study was carried out in all the 54 public secondary schools in Awgu Education zone. The population of the study was 118 biology teachers .The population was manageable, hence there was no sampling. The instrument for data collection was the researcher'. Developed questionnaire. The instrument was face validated by three experts in the faculty of Education, Enugu State University of Science and Technology Enugu. To determine the reliability of the instrument, 40 copies of the instrument were given to 40 Biology teachers in Agbani Education zone. To ascertain the internal consistency of the instrument, the Cronbach Alpha method was used to compute the internal consistency of the instrument. The computation yielded 0.88 for section A, and 0.79 for section B. Mean and standard deviation were used to answer the research questions while t test statistics method was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed that the general designs of the Biology Laboratories are relevant for implementation of safety practices in Biology Laboratories., among others.

RECOMMENDATIONS

Based on the findings, the following recommendations are proffered.

1. In general design of the biology laboratory, safety of the students and laboratory users should be the priority.
2. Well trained and experienced laboratory assistants should be employed to enable them arrange and label chemical and regent bottles properly to ensure implementation of safety practices in Biology laboratory.

REFERENCES

American Chemical Society, (2016) Chemical Safety and Laboratory Management Washington DC Academics Press.

Bell, P. (2014) The School Science Laboratory; Technology and Science Practices. Washington D.C, National Research Council Press

Hopper, U. Z. (2003) Safety Outreach Program Blacksburg V A Author.

Idodo Umeh, G. (2015) College Biology Idodo Ume Publishers Limited Benin City, Edo State Nigeria.

Idoko C. E (2011) Research in Education in and Social Sciences (Practioner's Companion) Enugu. Our Saviours Press Limited Enugu.

James Y. (2003) Interpersonal Behaviour, Laboratory Learning Environments, and Student Outcomes in Biology Classes. Journal of Research in Science Teaching 7(20) 26 – 34.

Kasin, M.R (2000). The Role of Safety Education (Technical Report No.10) Vowa city: University of Lowa Safety Education Centre.

Mark K. (2001) Research on Industrial Safety. In Dan Gable (Ed.) Hand o Research on Industrial Safety: New York: Macmillan

Peskin, J. (2002) South Carolina Statewide Science Safety Project. Journal of the South Carlina Academy of Science, 1(1), 19-23.

Procers, B.I, Guily. J. W. (1980), An Analysis of Laboratory Safety in Texas. Austin: Dana Centre of University of Texas, Austin.

Sirum, J. R., Humburg; H. J. (2016) Enhancing Science Education Through Laboratory Environment. International Handbook of Science PP 86-95) London England.

Wilson (2014), School Science Work. Some Issues of Policy. In Hegarty-Hazel (Ed.) The Student Laboratory and Science curriculum (PP223 – 228).